Identifying Optimal Site Location for Wind Energy Farms Considering Ecological and Social Impacts

Abstract

With the increasing cost and declining availability of fossil fuels, renewable energy, specifically wind power, has become one of the fastest growing sources of energy in New Mexico. To assist with the goals set by the state's Renewables Standard Portfolio established in 2004, the NASA DEVELOP team created three Optimal Wind Farm Suitability maps that consider social impact, ecological impact, and power production efficiency. Along with the National Renewable Energy Laboratory (NREL), project partners included the New Mexico Energy, Minerals & Natural Resources Department's Energy Conservation & Management Division (ECMD), and New Mexico Department of Game and Fish (NMDGF). The team utilized datasets from February 2013 – May 2018 including NASA Earth observations from the Shuttle Radar Topography Mission (SRTM) and Suomi National Polar-orbiting Partnership (NPP) to take into account vulnerable species, average wind patterns, and US Air Force Base locations. These three maps were combined into a final suitability map for optimal wind farm placement. Fuzzy Logic modeling was implemented to identify areas of low social and ecological impact and of high wind power productivity. The Land-Use Conflict Identification Strategy (LUCIS) combined the Fuzzy Logic model outputs to predict regions that may be overall suitable for wind farms.

Objectives

- **Showcase** SRTM and Suomi NPP VIIRS Day Night Band through site suitability analysis of possible locations for wind farm development
- **Assess** wind farm site suitability based on social factors such as Air Force bases, protected lands, and densely populated areas
- **Determine** site suitability based on ecological factors such as distribution of the golden eagle and lesser-prairie chicken
- **Identify** areas with the greatest wind power potential based on factors such as wind speed and elevation

Study Area

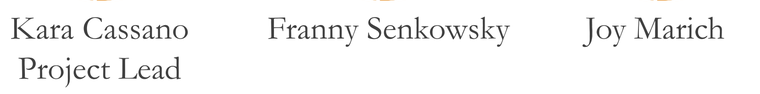
Project Partners

- **National Renewable Energy Lab**
- **New Mexico Energy, Minerals & Natural Resources Department, Energy Conservation & Management Division**
- **New Mexico Department of Game & Fish**

Methodology

Data Acquisition	Data Analysis	End Products
SRTM	Fuzzy Membership	Suitability of Sites Considering Low Ecological Impact Map
Suomi NPP	LUCIS Model	Suitability of Sites Considering Low Social Impact Map
Ancillary Datasets		Suitability of Sites Considering Wind Efficiency Map
		Optimal Wind Farm Suitability Map

Team Members

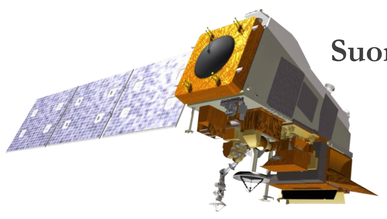


Kara Cassano
Project Lead

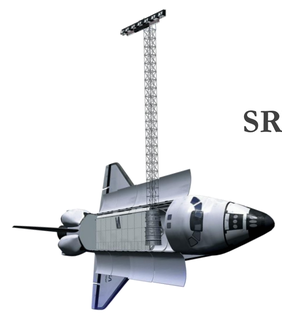
Franny Senkowsky

Joy Marich

Earth Observations



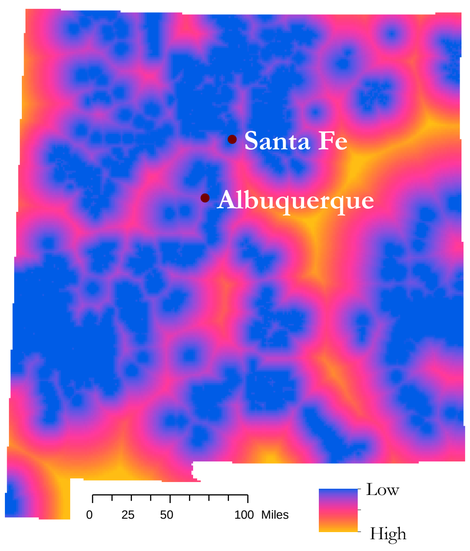
Suomi-NPP VIIRS



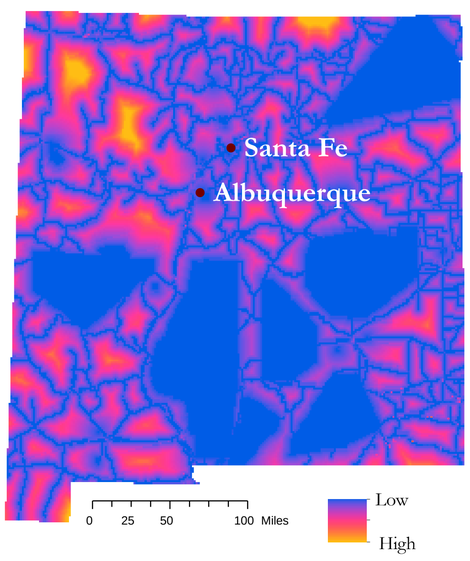
SRTM

Results

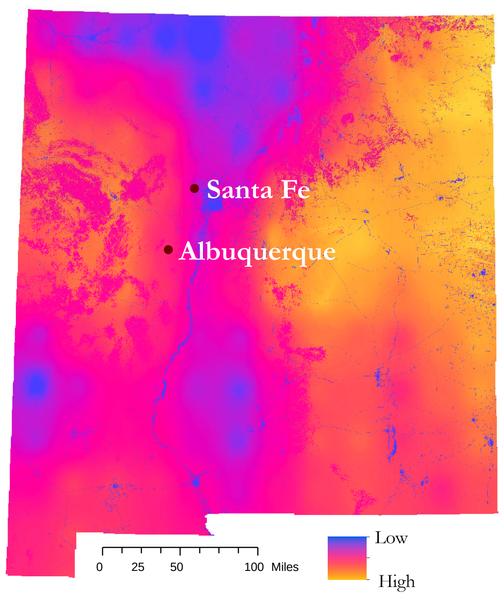
Suitability of Sites Considering Low Ecological Impact



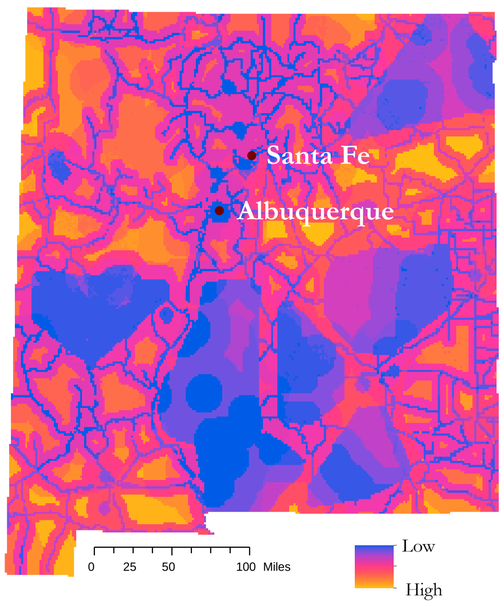
Suitability of Sites Considering Low Social Impact



Suitability of Sites Considering Wind Efficiency



Optimal Wind Farm Suitability



Conclusions

- NASA Earth observations can identify potential land use conflicts when conducting wind farm site suitability.
- Determining highly suitable areas for wind farms in New Mexico is difficult because there are many variables to consider, but there are highly suitable areas dispersed around the state.
- Fuzzy Logic and the LUCIS Model can identify areas potentially suitable for wind farm development, and suitability is impacted greatly the factors chosen such as Air Force Base locations, wind density, and lesser-prairie chicken and golden eagle distribution.
- Site suitability maps shared by the project partners with the public can facilitate conversation between various stakeholders regarding policy making and development.

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